

The Belgian Interbank Market: Interbank Linkages and Systemic Risk

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1. Introduction

Interbank markets play a major role in the functioning of the financial system. They provide an effective way of transferring liquidity from banks with a cash surplus to those with a cash deficit. At the macro-economic level, interbank markets strengthen financial integration but they also increase linkages and common exposures to risks within the banking sector. At the micro-economic level, individual institutions make use of interbank markets for their liquidity and risk management. As a consequence, these markets represent one of the most important channels of contagion through which problems affecting one bank/country may spread to other banks/countries.

In the same spirit as analyses undertaken by other central banks⁽¹⁾, this paper addresses implications of Belgian interbank linkages for financial stability. The main objective is to evaluate the risk that a chain reaction in the interbank market – i.e., a situation where the failure of one bank would lead to problems among one or more of its interbank creditors – could create wider systemic risk in Belgium.

The Belgian interbank market⁽²⁾ is very international and highly concentrated. This observation raises several interesting questions. How have consolidation and internationalisation affected the interbank market? To what extent could the failure of banks in another European country's banking system affect Belgian banks through interbank exposures? How has interbank contagion risk evolved over time? How does the assessment of contagion risk in Belgium compare with assessments in other countries?

Bank failures have historically been rare events, even more so in Belgium than in many other countries. Yet, because bank failures are not impossible, understanding the potential channels through which the failure of one bank (foreign or domestic) might affect Belgian banks is an important aspect of financial stability. Like the studies for other countries, we undertake a stylised, mechanical exercise⁽³⁾ – resembling a stress test – to examine the potential for interbank contagion to occur in Belgium. Namely, we investigate the consequences of non-repayment of interbank loans of a given bank on the capital of its bank lenders (and any further domino-like effects from the latter banks), under the assumption that no adjustments have been made in interbank exposures to the failing banks. This assumption implies clear limitations; for example, it rules out preventive measures that might be taken by regulators or individual banks, such as reducing exposures to the failing bank. More generally, the assumption excludes any behavioural changes (which could also include bank panics) arising from market expectations about failing banks.

In the analysis we distinguish between potential contagion initiated by the failure of a Belgian bank versus potential contagion risk from abroad, i.e. implied by the failure of a foreign bank. We also investigate how the risk of contagion associated with failure of a Belgian bank has evolved over time. In addition, we are partially able to take

(1) See, for example Wells (2002) for the UK, Upper and Worms (2002) for Germany. Analyses undertaken by other financial institutions include Sheldon and Maurer (1998) for Switzerland, and Furfine (1999) for the US.

(2) By Belgian interbank market, we refer here to the set of interbank exposures where at least one of the counterparts is a bank incorporated in Belgium.

(3) Although the studies cited in Footnote 1 differ in the ways in which they estimate bilateral interbank exposures, they all use mechanical contagion mechanisms.

into account the moderation of interbank contagion risk arising from the increasing use of risk mitigation techniques, such as collateralised interbank loans or repurchase agreements (repos).

The paper is organised as follows. Section 2 discusses the link between interbank markets and systemic risk. Section 3 examines important features of the Belgian interbank market that might have a bearing on contagion risk. Section 4 presents the results of the simulation exercise. Section 5 concludes.

2. Interbank markets and systemic risk

2.1 Raison d'être of interbank markets

The interbank market is part of the overall money market. The money market, in general, refers to the wholesale market for low-risk, highly liquid, short-term debt instruments (see e.g. Stigum, 1990). Banks trade liquidity, and therefore take on interbank exposures for two main reasons.⁽⁴⁾

First, banks need to pay out cash to customers on demand and to clear transfers of their customers' deposits to other banks. Deviations of actual liquidity needs from banks' expectations imply that banks may, ex-post, hold excess liquidity or need to obtain liquidity.⁽⁵⁾ Interbank markets are then used for risk sharing purposes, i.e. to manage bank-idiosyncratic liquidity shocks. Interbank markets thus allow financial intermediaries to offer improved risk sharing services to their clients.

Second, interbank markets are a convenient instrument for managing liquidity while simultaneously optimising banks' assets and liabilities management, by taking on exposures with the desired characteristics. Indeed, interbank markets may be used to hedge and transform other kinds of risks such as foreign exchange risk and interest rate risk.

2.2 Interbank markets and systemic risks

Contagion on interbank markets can occur in at least three types of situations: (i) when aggregate liquidity is insufficient, (ii) when the collapse of a bank induces a domino effect and (iii) when market expectations create spill-over effects. We now examine these three situations in more detail.

In the aggregate, the interbank market only redistributes liquidity across banks; it does not create liquidity. A lack of aggregate liquidity could occur, for instance, if banks have excessive confidence in the ability of interbank

markets to absorb transitory liquidity shocks, so that they under-invest in liquid assets (Bhattacharya and Gale, 1987). Interbank exposures may create problems if aggregate liquidity provision is insufficient. In this case, banks would try to avoid liquidation of their long-term assets, and would therefore liquidate their claims on other banks (possibly in other regions). A financial crisis in one region could then spread by contagion to other regions and thereby introduce liquidity problems in the latter (Allen and Gale, 2000). It should, however, be noted that in practice central banks play a key role in preventing aggregate liquidity shortages.

A second source of contagion is the domino effect itself. The failure of one individual bank may initiate a domino effect if the non-repayment of interbank obligations by the failing bank jeopardises the ability of its creditor banks to meet their obligations to their (interbank) creditors. Contagion occurs then "mechanically" through the direct interlinkages between banks.

"Spill-overs" through market expectations represent a third potential channel for contagion. For example, bank runs may occur when depositors observe other customers who face liquidity shocks withdrawing their funds from the bank. The depositors not facing liquidity shocks may decide to withdraw too, in the fear that they will ultimately be unable to recover their deposits (especially if banks must begin liquidating illiquid long-term assets in order to meet the high liquidity demand). These beliefs then become self-fulfilling (see Diamond and Dybvig, 1983). Other forms of market spill-over include withdrawals by depositors from (or unwillingness by other banks to provide liquidity to) a bank engaging in similar activities as those of a failing bank. Of course, regulatory intervention such as suspension of convertibility or deposit insurance may alleviate the problem of bank runs and banking panics (for an overview see Freixas and Rochet, 1997).

Factors that could influence the level of contagion risk include:

- *The structure of interbank linkages*: Interbank market structures that are "complete", where all banks have symmetric links with the other banks operating in the interbank market, appear to be less vulnerable to contagion than are "incomplete" market structures, where banks are only linked to some other banks of the system (Allen and Gale, 2000). Another possible

(4) It is, among other things, through the interbank market that central banks implement their monetary policy. Banks, in turn, are able to obtain liquidity from the central bank at a penalty interest rate, via the marginal lending facility.

(5) Note that a bank can also have excess cash or liquidity needs ex-post, without deviation from its expectations, if it is ex ante specialised in deposit raising or in lending and deliberately relies on interbank markets to absorb its excess cash or to provide liquidity afterwards.

form of interbank market structure is that of a “money centre,” where a bank at the centre is symmetrically linked to all the other banks without these banks being linked together. Freixas et al. (2000) analyse this type of structure and show that, in some cases, the failure of a bank linked to the money centre will not trigger the failure of the money centre, but the failure of the money centre itself may trigger failures of the linked banks.

- *Market concentration*: Economic theory does not provide an unambiguous response to the question of the impact of increasing concentration in banking markets on the stability of interbank markets, although some authors do find that such a trade-off exists in certain circumstances.⁽⁶⁾ However, concentration increases the probability of “too-big-to-fail” type intervention in a crisis, which may induce excessive ex ante risk-taking behaviour on the part of large banks and increase the risk of crisis. Moreover, in the absence of too-big-to-fail intervention, the severity of contagion may be reinforced by a high degree of concentration.
- *Risk mitigation techniques*: Risk mitigation techniques, such as collateralised interbank loans (e.g. repos) reduce the risks of contagion. On the other hand, the existence of a repo market may lead to the disappearance of the uninsured international interbank market (Freixas and Holthausen, 2001). This can occur as a result of asymmetric information; a bank that attempts to obtain an unsecured cross-border loan may be suspected of having had the loan denied by other domestic banks which have more information about the borrower.
- *Netting mechanism*: The use of netting contracts among banks is a mechanism for reducing interbank exposures. A problem at one bank is then less likely to initiate a “domino effect” on the interbank market. Emmons (1995), however, shows that netting of interbank claims shifts the bank default risk away from interbank claimants towards non-bank creditors, i.e. the risk is transferred to the banks’ creditors who are not included in the netting agreement.
- *Limits to large exposures*: Limits imposed by authorities on banks’ large exposures (see e.g., the 1992 EU Directive on the monitoring and control of large exposures of credit institutions) contribute to reducing contagion risk. Limits are usually formulated in terms of banks’ own funds. For example, the EU Directive states that a bank’s maximum exposure to a single counterparty may not exceed 25 p.c. of regulatory own funds, and the cumulative amount of individual exposures exceeding 10 p.c. of regulatory own funds may not exceed 800 p.c. of those own funds.

- *Central bank intervention*: Potential central bank intervention, as well as the presence of safety nets, lowers contagion risk. Central banks may decide to provide liquidity to the market as a whole when aggregate liquidity is insufficient, or directly to individual banks when the market fails to provide liquidity to sound financial institutions. Moreover, although interbank exposures are not explicitly covered by deposit insurance, issues such as “too-big-to-fail” may introduce implicit deposit insurance for these exposures.

3. Features of the Belgian interbank market

In the previous section we have highlighted the links between the structure of the interbank market and the risks of contagion. In this section we describe some important features of the Belgian interbank market, their evolution over time, and their potential impact on contagion. Two main features, which reflect two different dimensions of contagion risk, are considered: (i) the size of the market and (ii) the structure of interbank loans and deposits. The size of the market determines the maximal direct knock-on effect on the banking system of defaults on interbank loans. The structure of interbank loans and deposits, in particular their maturity and secured character, also influences the nature of contagion risks.

3.1 Size

Although aggregate interbank exposures of Belgian banks have increased over time (interbank loans represented a gross exposure of € 176 billion at the end of 2002 vs. € 92 billion at the end of 1992, while on the same dates interbank deposits amounted to € 228 billion vs. € 119 billion), their growth has paralleled that of total bank assets. Indeed, between Q4-1992 and Q4-2002, interbank loans grew at a compound annual rate of 6.8 p.c., compared to 6.6 p.c. for total assets, and interbank exposures now represent just a slightly higher fraction of total assets than ten years ago.⁽⁷⁾ Interbank loans of Belgian banks have consistently represented 20 to

(6) For an overview of these issues see e.g. Carletti and Hartmann (2002), Carletti et al (2002) examine the effects of bank mergers on reserve management and on interbank market liquidity. They argue that the probability of the banking system experiencing a liquidity shortage following a merger hinges on several factors, including the cost of refinancing on the interbank market relative to the cost of raising deposits and the structure of the post-merger liquidity shocks to banks’. Allen and Gale (2003) show that contagion is less likely to occur in imperfect competition than in a perfectly competitive interbank market. Indeed, in imperfect competition, banks’ actions affect the price of liquidity, leading banks to adopt strategical behaviour that may reduce contagion.

(7) Unless otherwise noted, the figures presented in this paper are reported on a company basis only. The interbank exposures represent interbank loans and deposits as reported in banks’ balance sheet data. They exclude assets, such as bank bonds, shares or off-balance-sheet instruments. The figures provide an estimate of the stock of interbank loans and deposits owned by Belgian banks at a particular point in time.

30 p.c. of their assets over the last decade, while their deposits accounted for 28 to 40 p.c. of their liabilities. As Chart 1 illustrates, these ratios are broadly in line with the average at the EMU level (at the end of 2001, EMU interbank loans accounted for 22 p.c. of total assets), although there are significant differences between countries such as Finland (3 p.c.) or Luxembourg (48 p.c.).⁽⁸⁾

Several factors have contributed to a recent reduction in the relative importance of interbank exposures of Belgian banks relative to their peak during the past decade. First, 1999 was marked by the transition to a single currency in the whole euro area. This reduced the number of currencies traded by Belgian banks and subsequently the need to take positions in them. Secondly, the adoption of more effective large payment systems with real time gross settlement led to a drop in bilateral accounts between banks, as well as to less recourse to correspondent banking networks. Thirdly, the major consolidation wave in the Belgian banking sector in recent years has coincided with a decrease in the volume of domestic transactions, since interlinkages between merging banks were offset. Finally, actions by several large foreign banks to centralise their treasury management operations may also have contributed to reducing interbank loans and deposits of their Belgian subsidiaries.

As can be inferred from Chart 1, interbank deposits and interbank loans evolve very similarly. However, the magnitude of their movements differs, so that the net position⁽⁹⁾ of the Belgian interbank market fluctuates, although it always

remains negative. At first sight, this dependence vis-à-vis foreign countries may appear to be a source of vulnerability. In reality, several alternative sources of liquidity could compensate for a potential outflow of interbank liquidity. Central banks, for instance, may intervene to ensure the smooth redistribution of liquidity. The portfolios of Belgian banks also include a large proportion of government bonds, giving them quick access to liquidity. Moreover, the situation of Belgian banks is far from exceptional. According to OECD statistics, several European countries also have a structurally negative interbank net position. This negative net position is due not only to the structure of their banking systems but also to differences in the tax treatment of deposits across countries.⁽¹⁰⁾ Finally, it should be noted that the net position of the Belgian banking system has tended to become less negative over the last five years.

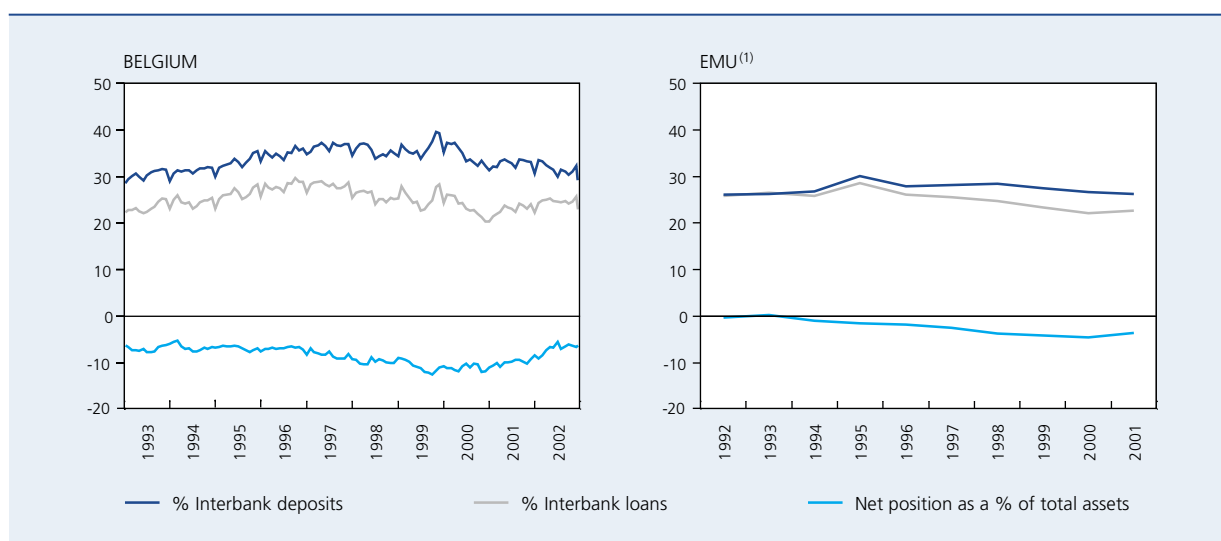
(8) According to the ECB (2002a), it is hard to find uniformity in the nature and importance of interbank activities across institutions and across countries because of the different banking structures characterising each EMU member.

(9) The interbank net position is defined as the difference between interbank loans (claims banks hold on other banks) and interbank deposits (claims other banks have on these banks). Hence, a negative net position implies that the interbank deposits are greater than the interbank loans.

(10) Huizinga and Nicodème (2001) find that non-bank international deposits are positively related to wealth taxes and to the presence of domestic bank interest reporting. This suggests that non-bank international deposits are in part determined by tax concerns. With regard to international interbank deposits, the tax treatment of deposits also undoubtedly plays a role, although it is not the sole driver. Chevallier-Farat (1988) reports, for instance, that the creation of off-shore areas in the United States in 1981 (International Banking Facilities) triggered massive movements of international interbank funds. Moshirian and Bishop (1997) show that international interbank movement of funds were determined, among other things, by the relative cost of capital (which is affected by differences in tax treatments) between countries. One partial explanation for the negative net position of the Belgian banking system could be the fiscal asymmetry between Belgium and its neighbouring countries, in particular Luxembourg. Due to the lenient tax treatment of savings in neighbouring countries, some neighbouring countries attract the savings of some Belgian households. This may explain why some banks of these countries have excess liquidity that they could lend afterwards to e.g. Belgian banks.

CHART 1 INTERBANK LOANS AND DEPOSITS OF BELGIAN AND EMU BANKS AS A P.C. OF TOTAL ASSETS

(Weighted average ; Belgian figures on a monthly basis ; EMU figures on an annual basis)



Sources : NBB, OECD.

(1) Greece, Luxembourg and Portugal : commercial banks only ; Ireland from 1995 onwards only.

TABLE 1 STRUCTURE OF INTERBANK LOANS AND DEPOSITS OF BELGIAN BANKS

(December 2002, percentages)

Origin of counterparty	Belgium	EMU	RoW	Total
Interbank loans				
Sight deposits	0.3	0.6	1.1	2.1
Term loans	6.2	27.2	12.9	46.3
Secured loans	6.1	18.5	24.8	49.4
Other	2.1	0.1	0.0	2.2
<i>Total</i>	<i>14.7</i>	<i>46.4</i>	<i>38.9</i>	<i>100.0</i>
Interbank deposits				
Sight deposits	0.3	1.3	1.3	2.8
Term deposits	7.3	11.7	35.4	54.4
Secured deposits	6.7	20.3	15.7	42.7
<i>Total</i>	<i>14.4</i>	<i>33.3</i>	<i>52.4</i>	<i>100.0</i>

Source : NBB.

3.2 Structure

Interbank loans and deposits show considerable heterogeneity in terms of their maturity, their secured character, and the counterparties. Indeed, these interbank exposures comprise several components: sight deposits, time loans/deposits, central bank accounts, monetary reserves and secured loans/deposits such as repurchase agreements⁽¹¹⁾ or collateralised lending (Table 1).

Secured loans/deposits and term loans/deposits are the most important categories of both interbank loans and deposits. Secured interbank loans of Belgian banks now account for about 50 p.c. of interbank loans and secured deposits for about 43 p.c. of interbank deposits, whereas at the beginning of the nineties, secured loans represented less than 10 p.c. of total interbank loans (Chart 2).

The recourse to secured loans and the use of repos have actually constituted a major change in the strategy of Belgian banks during the last decade. Initially, secured loans became more important for exposures between Belgian banks. Over the last five years, however, secured loans have also caught up for exposures between Belgian banks and foreign banks.⁽¹²⁾ This shift towards secured loans is an important change that we will keep in mind in interpreting the results of our contagion exercise in Section 4. In particular, the increased reliance on secured loans has probably contributed to a considerably lower risk of contagion by decreasing expected losses in case of default, by both Belgian and foreign interbank borrowers.

We may expect the use of secured loans to be further stimulated in the future by the EU directive on Financial Collateral.⁽¹³⁾

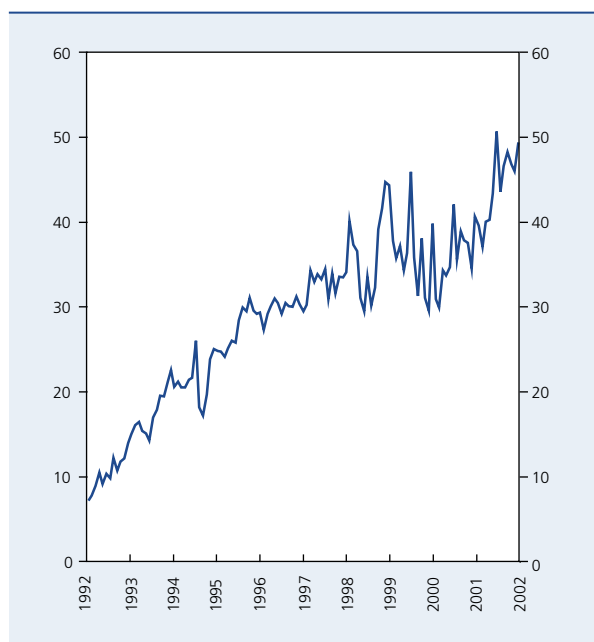
Another striking point revealed by Table 1 is the high level of internationalisation of the interbank market. Belgium is a particularly open economy, and so is its interbank market. A substantial share (more than 85 p.c.) of both interbank loans and deposits of Belgian banks is indeed cross-border. At the beginning of the nineties, this share already exceeded 70 p.c., and it has constantly increased since Q4-1998. These exceptionally high proportions of cross-border interbank loans and deposits highlight a feature of the Belgian interbank market which potentially transforms the risk of contagion, as well as the way it should be handled. Given that the lion's share of the interbank exposure is situated abroad, Belgian banks might be more sensitive to international crises than to domestic ones, and any attempt to assess the impact of interbank markets on Belgian financial stability must be viewed in that perspective. A significant step in this direction was taken with the agreement on the memorandum of

(11) A repurchase agreement (repo) is an agreement between two parties whereby one party sells the other a security with a commitment to repurchase it at a pre-specified date and price. Most repos are overnight transactions, with the sale taking place on the first day and being reversed the day after. A repo is considered as a loan since the party selling the security disposes of funds which have to be repaid afterwards. It is secured because the party that purchases the security holds it as collateral.

(12) The monetary policy reform in Belgium in 1991 fostered the use of repos between Belgian banks. Since the EU legislative framework on monetary policy was developed later, the use of collateral between EU banks also increased later.

(13) Directive 2002/47/EC of the European Parliament and of the Council of 6 June 2002 on financial collateral arrangements. See e.g. NBB (2002).

CHART 2 SECURED INTERBANK LOANS
(Percentages of total interbank loans)



Source : NBB.

Banks of the neighbouring countries (i.e. France, the Netherlands, Luxembourg, Germany and the UK) represent the most important interbank positions in the balance sheets of Belgian banks (Chart 3). This is not surprising since the UK, France and Germany all tend to operate as interbank centres. Moreover, the connections between Belgian banks and Luxembourg or the Netherlands are heavily influenced by the shareholder structures of large Belgian banks. Since Belgian banks have strong links with these countries, we will pay particular attention to them in our contagion exercise.

The maturity structure of interbank loans is also important for determining the consequences of potential contagion. Both interbank loans and deposits show a relatively short maturity (Table 2), and only 24.1 p.c. of interbank loans have a maturity exceeding 3 months.⁽¹⁵⁾ It thus seems that Belgian banks use interbank markets mainly to manage their short-term liquidity needs.

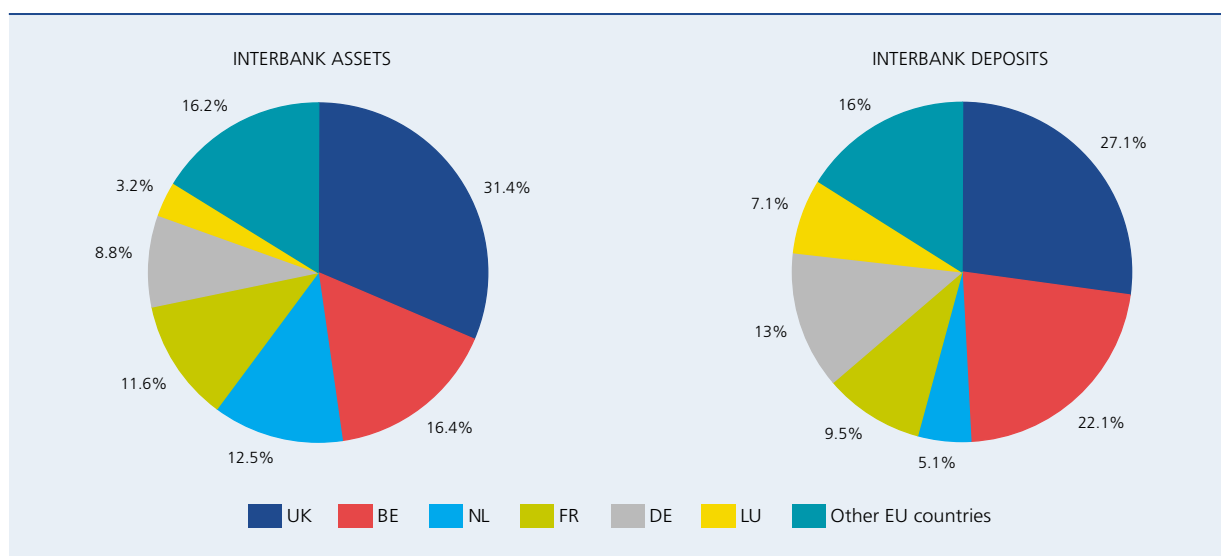
The interbank market is highly concentrated, as suggested by Table 3, which provides data on interbank exposures of banks by bank size groupings. Several observations follow from this table. First, the value of interbank loans and deposits correlates with bank size. Second, the

understanding on high-level principles of co-operation in crisis management by EU countries, which aims at co-ordinating interactions between supervisors and central banks at the EU level.⁽¹⁴⁾

(14) See ECB Press Release, 10 March 2003.

(15) Data on the German interbank market (Upper and Worms, 2002) indicate that more than 75 p.c. of the interbank assets and liabilities have a maturity exceeding 1 month and more than 50 p.c. of the interbank assets and liabilities have a maturity exceeding 4 years.

CHART 3 INTERBANK POSITIONS OF BELGIAN BANKS VIS-À-VIS EUROPEAN COUNTRIES
(December 2002, percentages, data on a territorial basis⁽¹⁾)



Source : NBB.

(1) Sample composed of the same banks as in the other tables.

TABLE 2 RESIDUAL MATURITY OF INTERBANK LOANS AND DEPOSITS OF BELGIAN BANKS

(December 2002, percentages)

	<= 8 days	8 days – 1 month	1-3 month	3-6 months	6 months – 1 year	> 1 year	Undetermined
Loans	28.0	22.6	25.3	11.5	8.4	2.9	1.3
Deposits	39.5	25.4	17.2	9.3	6.7	1.8	0.1

Source : NBB.

negative net interbank position of the Belgian banking sector is attributable almost exclusively to the negative positions of the four major banks (group G1). With the exception of group G3, all groups other than G1 have a positive net position.

A third observation suggested by Table 3 is that interbank activities with foreign banks are mainly concentrated in large Belgian banks. However, access to international interbank markets does not seem to be limited strictly to large banks. In particular, Belgian subsidiaries of foreign banks often have important intra-bank positions. Nevertheless, the proportion of foreign interbank loans and deposits tends to decrease with bank size. This may be true for several reasons. For instance, smaller banks may not reach the critical size necessary to conclude transactions on the international interbank market. Smaller banks could also be less known internationally, which could effectively deny them access to the international interbank market.

This would, in a sense, provide support for one of the scenarios presented by Freixas and Holthausen (2001), where large banks with a good international reputation act as correspondent banks for their domestic peers in order to overcome problems of asymmetric information.

3.3 Summary

Although the gross interbank exposures of Belgian banks have increased over time, interbank loans and deposits currently represent about the same percentage of total assets as ten years ago. Moreover, banks have increased their recourse to secured loans, and their interbank loans are mainly short term. The nature of contagion risk has likely been further affected by two trends: the continuing growth in the importance of cross-border interbank loans and increasing concentration of the Belgian banking market.

TABLE 3 INTERBANK EXPOSURES BY BANK SIZE CATEGORIES

(December 2002, billions of euros)

Group ⁽¹⁾	Percentages of banking sector assets	Interbank Loans				Interbank Deposits			
		Total Interbank Loans	Loans to EMU	Loans to RoW	Share of foreign loans in group total (Percentages)	Total Interbank Deposits	Deposits from EMU	Deposits from RoW	Share of foreign deposits in group total (Percentages)
G1	85.1	151.1	70.6	64.0	89.1	207.5	71.4	111.7	88.2
G2	11.2	18.3	9.4	3.0	67.6	13.2	3.9	4.9	66.8
G3	2.7	4.5	1.3	1.4	60.6	5.9	0.6	2.5	52.7
G4	0.8	1.9	0.4	0.3	36.3	1.6	0.0	0.6	38.6
G5	0.3	0.6	0.2	0.0	30.8	0.4	0.0	0.0	0.0
Total	100.0	176.5	81.9	68.7		228.6	75.9	119.7	

Source : NBB.

(1) The group G1 comprises the four large banks. The remaining 61 banks are grouped in G2 to G5 according to their size. Each group consists of 15 banks, except G5 which comprises 16 banks.

4. Simulation analysis of systemic risk on the Belgian interbank market

Section 3 has described some important characteristics of the Belgian interbank market; however, the extent to which these characteristics affect contagion risk was not formally investigated. This section presents the results of a contagion exercise⁽¹⁶⁾ – similar to the ones carried out by other central banks⁽¹⁷⁾ – whose objective is to quantify the effects of a sudden and unexpected failure by a banking counterparty of Belgian banks at a specified point in time. As noted earlier, the approach is rather mechanical as it does not take into account the behaviour of the various players (banks, regulators) or their (changes in) expectations. It therefore does not aim to depict the exact reactions of interbank players in a crisis. Rather, it is an exercise designed to analyse a stress situation created by interbank market linkages and, in the cases where contagion occurs, to investigate how it would spread and the amount of bank losses that would result.

The interbank exposure data used in the analysis are reported on a company basis only; i.e. they include the foreign branches of Belgian banks and Belgian subsidiaries of foreign banks, but they do not include foreign subsidiaries of Belgian banks or Belgian branches of foreign banks. Unreported results show that the figures, when available, do not differ significantly when based on other data (collected on a territorial or consolidated basis). Interbank exposures represent interbank loans and deposits as reported in banks' balance sheet data. Other types of assets, such as bank bonds, shares or off-balance-sheet instruments, are not reported.

4.1 Overview of the methodology

In order to quantify contagion risk, we have successively simulated the consequences of default on interbank obligations of each individual Belgian or foreign banking counterparty. In the exercise (see Box 1 for details on the methodology), we define bank "failure" following default by an interbank borrower as a situation where the lender bank's tier-I capital becomes negative as a result of the default. The extent to which the lender's capital decreases following the borrower's default depends on both the exposure at default and the loss given default (LGD). As explained in the Box, the initial default of a bank on its interbank obligations may cause successive rounds of defaults. The contagion effect ends when banks that defaulted during the last round do not cause any new bank defaults.

This exercise requires information on bilateral interbank exposures of Belgian banks. We estimate these exposures via two methods. We first use banks' reported large interbank

exposures (exceeding 10 p.c. of own funds, together with the name of the counterparty).⁽¹⁸⁾ We then use a second source of information – the total amount of interbank loans and deposits reported by each individual bank. The simulation technique with the latter source of information requires making an assumption regarding the distribution across other banks of each bank's total exposures. Following other similar studies, we assume maximum dispersion of these exposures across banks (see Box 1 for details).

These two estimation techniques, and the general contagion exercise, involve biases – some of which tend toward underestimation and others toward overestimation of contagion risk.⁽¹⁹⁾ The sources of bias are summarised below. The extent to which contagion risk will actually be underestimated or overestimated in our simulations will obviously depend upon the importance of each of these sources.

Factors causing underestimation of contagion risk:

- Measure of interbank exposures, which includes interbank loans and deposits only and does not include other interbank exposures, such as off-balance-sheet exposures.
- Distributional assumption of maximum dispersion of banks' interbank exposures (see Box 1).
- Indirect effects of the failure of foreign banks are not taken into account, since we are not able to measure contagion between foreign banks.⁽²⁰⁾
- Credit risk is the only source of interbank contagion; liquidity risks⁽²¹⁾ are ignored.
- Conservative definition of bank failure: banks may fail before their tier-I capital is exhausted.

(16) The full contagion exercise, as well as the methodology used and its shortcomings, is presented in detail in Degryse and Nguyen (2003).

(17) See e.g. Upper and Worms (2002) or Wells (2002).

(18) The extent to which the large interbank exposures cover a bank's total interbank exposures varies from one bank to another. The large exposures reported by the five largest Belgian banks' covered on average about 70% of their total interbank exposures as reported in their balance sheets. The non-reported exposures probably represent a smaller risk in terms of contagion.

(19) A bias against contagion minimises Type II errors, i.e. incorrectly accepting a false hypothesis. This implies a trade-off in terms of Type I errors, i.e. incorrectly rejecting a true hypothesis. In other words, in the presence of a bias against contagion, we might be able to state that there is a potential for contagion. On the other hand, we would not be able to say that contagion is non-existent.

(20) When we measure the impact on Belgian banks of the failure of a foreign bank, we disregard the "foreign second and further round effects". However, the failure of a foreign bank is likely to have an impact on its domestic market, and some foreign banks (possibly counterparties of Belgian banks) may default subsequent to the first failure, worsening the overall situation of Belgian banks. We undertake a type of sensitivity analysis in Section 4.2.2 to try to compensate for this limitation.

(21) Liquidity risk is the risk that a bank experiences a liquidity shortfall because its counterparty fails to meet its obligations. For instance, a bank may face a liquidity shortfall because its counterparty postpones a repayment or because it takes time to realise collateral.

- Bank panics by depositors assumed not to occur.⁽²²⁾

Factors causing overestimation of contagion risk:

- Banks assumed not to be able to refinance or to raise additional capital.
- Banks assumed not to anticipate crises and reduce their interbank exposures.
- Safety nets assumed absent.
- Measure of interbank exposures is on a company basis and not on a consolidated basis.⁽²³⁾

The fact that the contagion exercises are mechanical and potentially involve biases suggests that the results reported below should be interpreted in much the same spirit as those of a stress test. Yet, despite the caution that must be exercised in interpreting the results, this type of exercise represents one of the only means of obtaining any quantitative assessment of interbank contagion risk. This type of exercise has also been undertaken by other central banks and thus allows for some international comparisons. The results may provide general indications regarding the relative importance of different sources of interbank contagion.

(22) Bank panics may occur following an individual bank's failure if depositors make inferences about systemic weakness based on observation of the individual failure (see Aghion et al., 2000).

(23) Interbank exposure data were not available on a consolidated basis. Although the use of data at a company level leads to the implicit assumption that cross-border intra-group exposures are between different banks, our actual simulations reveal few cases where such exposures cause "contagion".

Box 1

Methodology of the contagion exercise

The methodology applied in this paper is based on Upper and Worms (2002), and aims at assessing the impact on the Belgian financial system of the sudden and unexpected failure of each banking counterpart of Belgian banks. The contagion test uses the matrix of interbank bilateral exposures, \mathbf{X} , to study the crisis propagation mechanisms. The matrix \mathbf{X} of bilateral exposures summarises the interbank exposures of Belgian banks towards the other ($\mathbf{N-I}$) Belgian banks and the \mathbf{M} foreign banks:

$$\mathbf{X} = \left[\begin{array}{ccccc|ccc} x_{11} & \cdots & x_{1j} & \cdots & x_{1N} & w_{11} & \cdots & w_{1M} \\ \vdots & & \vdots & & \vdots & \vdots & & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{iN} & \vdots & & \vdots \\ \vdots & & \vdots & & \vdots & \vdots & & \vdots \\ x_{N1} & \cdots & x_{Nj} & \cdots & x_{NN} & w_{N1} & \cdots & w_{NM} \end{array} \right]$$

$$\text{with } \sum_{j=1}^N x_{ij} = a_i = \sum_{i=1}^N x_{ij} = l_j \text{ and } \sum_{j=1}^M w_{ij} = fa_i$$

where x_{ij} represents the gross exposure of bank i to the Belgian bank j , w_{ij} represents the gross exposure of bank i to the foreign bank j , a_i represents the Belgian interbank assets of bank i , l_j represents the Belgian interbank liabilities of bank j and fa_i represents the foreign interbank assets of bank i .

The simulations successively study the impact of the failure of one of the \mathbf{N} Belgian banks or one of the \mathbf{M} foreign banks for a given \mathbf{LGD} . The initial failure causes an additional failure when the exposure of one bank to failed banks is large enough to offset its tier-I capital. More specifically, the bank i fails following other failures when

$$C_i - \sum_{j=1}^N \theta x_{ij} - \sum_{j=1}^M \theta w_{ij} < 0$$

for all banks j that failed

where C_i refers to the tier-I capital of bank i and θ refers to the **LGD**. The **LGD** is assumed to be constant and identical for all the failed banks. We use the gross exposures x_{ij} and w_{ij} instead of the netted ones ($x_{ij} - x_{ji}$), since in case of bankruptcy, netting would appear to be unlikely to occur. The initial default may cause several rounds of failures when the combined effects of the failed banks trigger new failures at each round. The contagion effect ends when banks that failed during the last round of failures do not cause any additional failures, i.e. when the system is again stable.

The matrix of bilateral exposures is unknown. Similarly to Wells (2002), we use two alternative assumptions to solve this problem. The first one consists of using a matrix of bilateral exposures based on large exposures only. The second one entails using the information contained in each bank's total exposures to Belgian banks a_i and l_j and making an assumption on how they are distributed in the matrix.

Banks report their exposures (including their interbank exposures) exceeding 10 p.c. of their own funds. This source of information allows us to fill in several cells in the matrix of bilateral exposures but does not provide the full matrix since it omits smaller exposures, which are probably less significant in terms of contagion risk. These data do not require any additional assumption on the distribution of exposures and they include exposures to foreign banks.

The second technique, which is commonly used in computing input-output tables and frequently used in contagion exercises, is based on the observed a_i and l_j which only provide incomplete information on interbank exposures, i.e. the column and row sums of the matrix \mathbf{X} , or the marginal distribution of the x_{ij} . Since the information is partial, we need to make an assumption on the distribution of the individual interbank exposures. We assume that banks seek to maximise the dispersion of their interbank activities. With the appropriate standardisation, this would be equivalent to assuming that $\mathbf{X} = \mathbf{X}^0$ such that $x_{ij} = a_i l_j$. However, such a distribution would neglect an important feature of the interbank market which is that banks do not have interbank exposures to themselves, so we have to add the constraint that $x_{ij} = 0$ for each x where $i = j$. The constrained matrix of bilateral exposures should stay as close as possible to \mathbf{X}^0 . Technically, this is equivalent to minimising the distance function (measured by the relative entropy) between \mathbf{X}^0 and the constrained matrix. This can be done by solving the following problem :

$$\min \sum_{i=1}^N \sum_{j=1}^N x_{ij} \ln \left(\frac{x_{ij}}{x_{ij}^0} \right)$$

$$\text{subject to } \sum_{j=1}^N x_{ij} = a_i ;$$

$$\sum_{i=1}^N x_{ij} = l_j ;$$

$$x_{ij} \geq 0 ;$$

$$\text{with the convention that } x_{ij} = 0 \text{ when } x_{ij}^0 = 0, \text{ and } (0 \ln(0/0)) \text{ is defined to be } 0.$$

This kind of problem is easily solved with the **RAS** algorithm⁽¹⁾. This approach, however, allows us to construct a matrix of bilateral exposures between Belgian banks only, so, when we use the second technique, we unfortunately do not have any information on foreign banks.

(1) See e.g. Blien and Graef (1997).

4.2 Results

4.2.1 Contagion triggered by the default of a Belgian bank

Table 4 reports results of our contagion exercise under the assumption that the initial interbank defaulter (the so-called “first domino”) is a Belgian bank. In December 2002, there were 65 banks incorporated in Belgium, i.e. 65 potential sources of contagion. The first panel of the table presents results where bilateral exposures were estimated on the basis of the large exposure data, and the second panel on the total interbank exposure data (maximum entropy distribution). As Table 4 shows, the frequency of contagion occurring in the simulations is limited. Under the extreme assumption of 100 p.c. loss given default (LGD), no more than 12 unexpected Belgian bank failures cause the failure of at least one other Belgian bank. The knock-on effects are also limited. Indeed, in a worst-case scenario⁽²⁴⁾, banks that would lose their tier-I capital as a result of the interbank defaults in the simulations would never represent more than 3.8 p.c. of the total assets of Belgian banks.⁽²⁵⁾ Thus, the default of a Belgian bank in the interbank market cannot,

in the context of this exercise, cause a large Belgian bank to lose all of its tier-I capital. Moreover, if we assume an LGD of 40 p.c., which would probably be more realistic given that secured loans account for more than 50 p.c. of total interbank loans⁽²⁶⁾, the losses are lower. Finally, in the median scenarios⁽²⁷⁾, the percentages of assets represented by banks losing their tier-I capital are considerably lower than in the worst-case scenarios.

Interestingly, contagion between Belgian banks does not appear to have always been this low.

(24) The worst-case scenario is the scenario for which the percentage of total banking assets represented by banks losing their entire tier-I capital is greatest.

(25) This figure comes from the entropy maximisation simulations. The figure decreases to 3 p.c. for the simulations using large exposure data.

(26) The statistical estimation of an LGD for Belgian banks is very difficult, since fortunately very few Belgian banks have failed in the last decades. Moreover, actual losses on a defaulting bank can prove very complicated to calculate, since they depend on the time horizon chosen. Altman and Kishore (1996) estimate average recovery rates on defaulting bonds of financial institutions (for the period 1978-1995) to be about 36 p.c. However, recovery rates vary by type of institution: mortgage banks, 68 p.c.; finance companies, 46 p.c.; financial services, 42 p.c.; commercial banks, 29 p.c.; savings institutions, 9 p.c.. However, the LGD for bonds is probably very different from the LGD for comparable loans (which in our case comprise secured and unsecured assets). James (1991) estimates that losses average 30 p.c. of the failed bank's assets and that the direct expenses associated with bank closures average 10 p.c. of assets, making a total of about 40 p.c.. Seeing that more than 50 p.c. of interbank loans granted by Belgian banks are secured, it may therefore be realistic to assume a recovery rate of somewhere between 60 and 80 p.c. (i.e. an LGD between 40 and 20 p.c.).

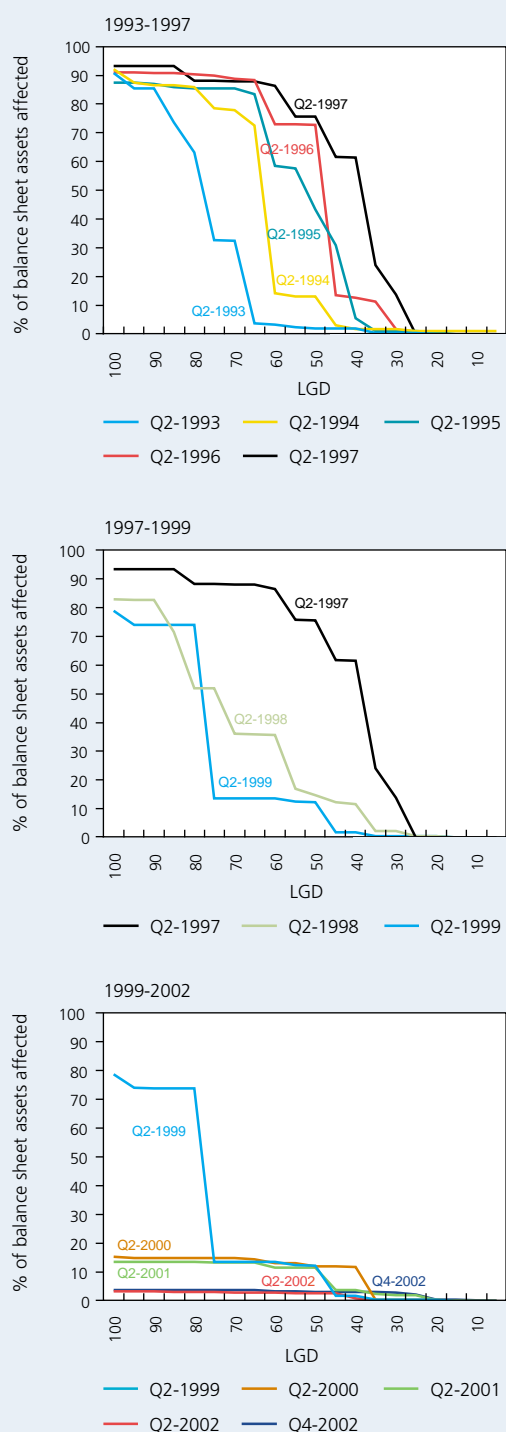
(27) The median scenario gives the median value, across all of the scenarios where contagion occurs, of the percentage of total banking assets represented by banks losing their tier-I capital.

TABLE 4 CONTAGION EXERCISE: BELGIAN BANK AS INITIAL DEFAULTER

LGD (Percentages)	Number of scenarios where contagion occurs (out of 65 possible scenarios)	Maximum number of failed banks in a scenario, (including “first domino”)	Median scenario Percentages of balance sheet assets affected (excluding assets of “first domino”)	Worst-case scenario Percentages of balance sheet assets affected (excluding assets of “first domino”)
Large Exposures at Q4 – 2002				
100	12	12	0.46	2.97
80	10	11	0.44	2.27
60	10	8	0.16	1.77
40	7	6	0.14	1.77
20	3	3	0.03	0.14
Maximum entropy distribution at Q4 – 2002				
100	4	18	3.33	3.79
80	4	17	2.13	3.75
60	4	13	1.73	3.33
40	2	11	2.98	3.04
20	2	5	0.50	0.50

Source : NBB.

CHART 4 CONTAGION EFFECT : WORST-CASE SCENARIO
(1993-2002)



Source : NBB.

Our contagion exercises conducted on historical data (using the maximum entropy distribution) show that, over the last decade, the worst-case scenarios in the case of contagion triggered by a Belgian bank have been subject to three major changes (Chart 4). Between 1992 and 1997, the worst-case scenario consistently worsened. Between 1997 and 1999, the worst-case scenario improved; i.e., the curve in Chart 4 decreased each year. Finally, since 1999 the curve has flattened. Thus, the amount of contagion generated in simulations with current data appears to be at a record low.⁽²⁸⁾ These trends are particularly striking for an LGD of 40 p.c. In this case, the percentage of total banking assets affected by contagion, excluding the first domino, varies over the time period from 61 p.c. to 3 p.c..

Several changes in the banking landscape could explain the results of these historical simulations. Between 1992 and 1997, the share of interbank assets in total assets tended to increase. This amplified the exposure of Belgian banks to other Belgian banks and increased the potential consequences of contagion in the worst-case scenario. Since 1997, mergers may have had an impact on the worst-case scenario. Large banks now seem to show an increased tendency to operate as money centres, where the failure of a bank linked to the money centre does not trigger the failure of the money centre itself. The decrease over time in medium-sized players, which were large enough to cause other banks to "fail" in the contagion exercise, also dampened the contagion effect observed over time in the simulations. Moreover, following consolidation, large banks have further increased their cross-border interbank exposures.⁽²⁹⁾ The bilateral interbank exposures between the large Belgian banks are now such that they no longer cause contagion in the simulations, although the failure of a large bank does still trigger the failure of small banks in the simulations.

This decrease in contagion over time for the domestic market simulations is potentially reassuring, although as noted earlier, these simulations may under- or overestimate the actual risk of contagion. Interbank loans to Belgian counterparts, however, constitute only a small portion of Belgian banks' interbank loans, and a decrease in domestic contagion risk could have been accompanied by an increased sensitivity of Belgian banks to the international interbank market. This suggests the need for an assessment of contagion risk triggered by foreign banks.

(28) Unreported tests show that the trends observed are not sensitive to the quarter chosen although in some rare cases and for some specific LGDs, the percentage of balance sheet assets affected by contagion might diverge from the general trend.

(29) Although the share of international interbank loans has always been high for large banks, it has increased over the last decade. In December 1992, the interbank loans granted by large Belgian banks to foreign banks accounted for 79 p.c. of total interbank loans. This proportion reached 89 p.c. at the end of 2002.

TABLE 5 CONTAGION EXERCISE: FOREIGN BANK AS INITIAL DEFAULTER

(Q4 – 2002, based on data on Belgian banks' large exposures)

LGD (Percentages)	Number of scenarios where contagion occurs (out of 135 possible scenarios)	Maximum number of failed Belgian banks in a scenario	Median scenario Percentages of Belgian banks' balance sheet assets affected	Worst-case scenario Percentages of Belgian banks' balance sheet assets affected	Long Term Fitch credit rating of the first foreign bank to fail in the worst case scenario ("first domino")
100	13	8	0.1	20.0	AA–
80	9	8	0.0	20.0	AA+
60	8	6	0.0	18.2	AA+
40	3	3	0.1	18.1	AA+
20	1	3	0.1	0.1	A

Source : NBB.

4.2.2 Contagion triggered by the default of a foreign bank

About 85 p.c. of Belgian interbank loans are granted to foreign banks. Foreign interbank positions thus represent a potential source of contagion that may be more important than domestic contagion risk. We therefore extend the contagion exercise to the foreign interbank market. Absence of data on the total interbank exposures of foreign banks, however, prevents us from using the maximum entropy technique for our simulations. The simulations are therefore limited to use of Belgian banks' large exposure data.

Table 5 reports the results of the contagion simulations when a foreign bank is the first defaulter (the "first domino") and when large exposure data are used. This table shows that given a 100% LGD the default of one large foreign bank can lead to the failure of 8 Belgian banks. In the worst-case scenario, the assets represented by Belgian banks losing their tier-I capital account for 20 p.c. of total Belgian bank assets. This result is considerably higher than the comparable figures for contagion simulations with Belgian banks as first dominos. Table 5 also indicates that even for an assumed LGD of 40 p.c., the default of a foreign bank can, in the worst-case scenario, have a significant impact on Belgian banks. Note that a small number of scenarios represented in Table 5 are due to cross-border intra-group positions; however, these scenarios represent exceptions rather than the rule.

Interestingly, contagion occurs less frequently (in less than 10 p.c. of cases) in the foreign-bank failure simulations than in the simulations where the first domino is a domestic bank. At most 13 of the 135 foreign counterparties listed by Belgian banks (in their reporting of large exposures) trigger contagion in the exercise. However, as the above discussion suggests, when cases of simulated contagion by foreign bank failure occur, they can affect a larger proportion of Belgian banking assets. Note, how-

ever, that large differences exist between the median and the worst-case scenarios. For an LGD of 100 p.c., only 3 of the 13 simulations that involved contagion entailed the failure of banks representing at least 10 p.c. of the total assets of the Belgian banking system. In addition, all of the foreign banks representing the first domino in the worst-case scenarios are European banks and all are ranked as investment grade, which suggests that actual interbank defaults by these banks are unlikely. Unfortunately, the absence of a long time series of bank large-exposure data prevents us from studying changes in the international risk of contagion over time.

As noted above, this contagion analysis cannot incorporate indirect effects of the failure of foreign banks (i.e., failure of other foreign banks as a consequence of failure of a given foreign bank). One way to roughly take account of indirect effects is to use data on exposures of

TABLE 6 SENSITIVITY OF BELGIAN BANKS TO LOSSES ON THEIR INTERBANK EXPOSURES TO FRANCE, THE UK, AND THE NETHERLANDS

(December 2002; assets of failed Belgian banks as a p.c. of total assets of Belgian banks; calculations based on data on a territorial basis)

Percentage default of country's interbank exposures	France	UK	Netherlands
100	22.2	93.6	41.8
80	22.2	41.5	40.6
60	21.8	39.8	40.1
40	0.0	39.7	0.5
20	0.0	0.0	0.5

Source : NBB.

Belgian banks to entire countries, instead of exposures to individual counterparts. Table 6 presents results of simulations where we assume that x p.c. of the interbank loans granted by Belgian banks to banks in a particular country are unrecoverable. The table reports only those simulations for which the total assets of failed Belgian banks resulting from the cross-border defaults exceeds 1 p.c. of total Belgian bank assets. For instance, in this exercise, if Belgian banks suddenly become unable to recover 80 p.c. of their interbank loans to French banks, Belgian banks representing 22 p.c. of the total assets of Belgian banks would incur losses (directly or indirectly) exceeding their tier-I capital. It is perhaps surprising to observe that apart from France, the Netherlands and the United Kingdom, simulations involving defaults on other countries' interbank loans (including Germany and Luxembourg) do not result in significant contagion in the Belgian banking sector. For instance, if we were to simulate the consequences of Belgian banks losing 100 p.c. of their exposures to German banks, the Belgian banks losing all of their tier-I capital as a result would represent less than 1 p.c. of total Belgian bank assets. Moreover, when we use more realistic loss rates, only the UK simulations yield significant levels of contagion in Belgium. This in fact reflects Britain's role as a money centre and the importance of British banks in the Belgian interbank market.

The results of this section suggest that, in the Belgian context, the international risk of contagion may deserve more attention than domestic contagion risk.

4.2.3 International comparison

Our study is closely related to other empirical work on estimating contagion through interbank linkages.⁽³⁰⁾ Sheldon and Maurer (1998) study the issue of systemic risk in the Swiss interbank market. They conclude that the number of potential cases of contagion arising from interbank linkages in Switzerland is quite low. However, the failure of a large Swiss bank would have serious implications, affecting almost all average-size banks. Furfine (1999), using data on bilateral exposures stemming from overnight U.S. federal funds transactions, finds that multiple rounds of failures are unlikely, and that aggregate assets at failing banks never exceed 1% of total assets of the commercial banks. The results of Upper and Worms (2002) for the German interbank market suggest, however, that the contagion risk is not always confined to a limited number of small banks. Indeed, they conclude that a bank failure can trigger contagion in a sizeable part of the German banking system, although safety nets considerably reduce this risk. Wells (2002) finds that contagion would only occur following the failure of some large UK banks, which

generally have a high credit rating. Finally, Elsinger et al. (2002), using a model that considers both credit risks and market risks and that endogenously determines the interbank flows, distinguish between fundamental (directly caused by a shock) and contagious insolvency. Their simulations indicate that in Austria, 97 p.c. of insolvencies may be classified as fundamental whereas only the remaining 3 p.c. are due to contagion.

Our results have suggested that interbank contagion risk in Belgium has evolved over time. Any attempt to compare our results with the results of simulations for other countries must therefore take this time dimension into consideration. Table 7 compares our results with other studies using the same methodology. It indicates that the simulated failure of a Belgian bank in December 1998 produced weaker contagion effects than the failure of a German bank in the same period, at least for high LGDs. Indeed, the worst-case scenario curves are higher for the German banking system than for the Belgian system except for the case of an LGD of 40 p.c.. When we compare our results with those of Wells (2002) for the UK, which uses data for end 2000, we find that the Belgian simulations produced a greater impact of contagion than for the UK. However, contagion occurred in a higher proportion of cases in the UK.

4.2.4 Institutional arrangements decreasing the risk of contagion

In recent months there have been several institutional initiatives aimed at decreasing the risk of (cross-border) financial contagion. We briefly mention two of them here: the Financial Collateral Directive and the Memorandum of Understanding on high-level principles of co-operation in crisis management.

The use of cross-border financial collateral in the European Union has been facilitated by the Financial Collateral Directive adopted by the European Parliament in 2002. This directive aims at encouraging the cross-border use of financial collateral, mainly by eliminating legal uncertainty concerning the use of collateral and by providing a uniform regime for banks with regard to the taking of financial collateral. This could further stimulate the cross-border integration of interbank markets.⁽³¹⁾

Banking supervisory authorities and the central banks of the European Union have recently agreed on a Memorandum of Understanding on high-level principles

(30) As previously mentioned, contagion can propagate through other channels. Spillovers through market expectations could for instance have increased for large banks, as shown by their increasing interdependencies as measured by their stock return correlations, see for instance De Nicolo and Kwast (2001).

(31) See NBB (2002).

TABLE 7 INTERNATIONAL COMPARISONS

LGD (Percentages)	Case of multiple failures triggered by a domestic bank	Maximum number of failed banks in a scenario, (including "first domino")	Median scenario Percentages of balance sheet assets affected (excluding assets of "first domino")	Worst-case scenario Percentages of balance sheet assets affected (excluding assets of "first domino")
Maximum entropy distribution – Belgium December 1998⁽¹⁾				
75	7	34	0.50	56.00
50	2	21	14.49 ⁽²⁾	28.46
40	2	16	7.69	14.87
25	1	2	0.50	0.50
10	0	1	–	0.00
Upper and Worms (Germany) end December 1998⁽³⁾				
75	n.a.	2,444	0.85 ⁽⁴⁾	76.30
50	n.a.	1,740	0.66 ⁽⁴⁾	61.60
40	n.a.	115	0.58 ⁽⁴⁾	5.00
25	n.a.	31	0.30 ⁽⁴⁾	0.75
10	n.a.	19	0.26 ⁽⁴⁾	0.57
Maximum entropy distribution – Belgium December 2000⁽⁵⁾				
100	5	36	3.16	61.92
80	5	21	3.10	13.86
60	4	16	0.43	11.64
40	4	4	0.40	0.43
20	3	2	0.39	0.39
Wells (United Kingdom) end 2000⁽⁶⁾				
100	4	n.a.	8.80	25.20
80	4	n.a.	1.00	6.70
60	3	n.a.	0.00	6.70
40	2	n.a.	0.00	0.00
20	0	n.a.	0.00	0.00

Sources : Upper and Worms (2002), Wells (2002), NBB.

(1) Out of 80 cases.

(2) Because the median is calculated on the basis of a very few scenarios, it can decrease when the LGD increases.

(3) Out of 3,246 banks.

(4) Average instead of median – not conditional on multiple failure.

(5) Out of 72 cases.

(6) Out of 33 cases.

of co-operation in crisis management situations. This MoU entered into effect on March 1, 2003.⁽³²⁾ With the adoption of this memorandum, the authorities have expressed their commitment to co-operate to ensure the stability of the financial system at the EU level. This agreement enhances the practical arrangements for handling banking crises in order to facilitate an early assessment of the systemic risk of a crisis.

5. Concluding remarks

In this paper we have undertaken an empirical exercise to investigate the risk of contagion due to interbank exposures of Belgian banks. We have used existing information on the total amounts of interbank exposures of Belgian banks as well as banks' reported large interbank exposures.

Before summarising our main findings, we point again to the mechanical nature of our methodology. In our simulations, we start from data on interbank exposures and track the consequences of non-repayment of

(32) See ECB Press Release, 10 March 2003.

(a fraction of) interbank loans on the equity capital of other banks, including any further domino-effects. This methodology does not allow for incorporating the role of market expectations or potential preventive measures taken by regulators and individual banks. Nevertheless, the exercise provides some insights regarding the potential impact of “stress” situations on the financial system.

Our simulations suggest that the risk of contagion due to domestic interbank defaults has decreased over the past decade. However, interbank exposures between Belgian banks currently represent only 15 p.c. of total Belgian interbank exposures, suggesting that the potential contagion risk stemming from foreign interbank exposures is more important. Our simulations indeed suggest that the failure of some foreign banks could have a sizeable effect on Belgian banks’ assets.

The threat of contagion originating from foreign interbank borrowers, however, is mitigated by two main factors. First, our simulations indicate that cross-border

interbank defaults have a major effect on the Belgian financial system only for high values of loss given default (LGD). Belgian banks currently maintain relatively high proportions of secured interbank exposures, which tend to lower LGDs. Second, the foreign banks whose interbank defaults had significant effects in our simulations are all internationally recognised and have high investment grade ratings.

The current structure and characteristics of the Belgian interbank market reflect several changes that have taken place over the past decade. Integration of money markets at the European level, increased recourse by banks to secured interbank exposures and several major mergers between Belgian banks have resulted in a trend towards market tiering and appear to have reshaped the risk of contagion. In the coming years changes in the microstructure of interbank markets may further alter the structure of interbank markets, thus keeping alive the debate about interbank contagion risk.

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